

### **REMARKS**

Attached hereto is a marked-up version of the changes made to the specification by the current amendment. The attached page is captioned **"Version with Markings to Show Changes Made."**

Claims 1 to 14 are currently pending in this application and have been examined in the present Office Action.

The Examiner objected to the Abstract as containing language which may be implied. By the present Amendment, the Abstract is amended. Applicants believe that the objection to the Abstract should be properly withdrawn.

Claims 1-14 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. By the present Amendment, commas are inserted around the phrase "such as carbon" in claim 1. Also, claims 12-14 are amended so as to properly depend from claim 10 which is a device.

The Applicants gratefully acknowledge that the Examiner indicated that method claims 1-9 would be allowable if rewritten to overcome the rejection under 35 U.S.C. §112, second paragraph. Applicants believe that the present Amendment is responsive to this rejection and that the

rejection under 35 U.S.C. §112, second paragraph, should be withdrawn from both method claims 1-9 and the product-by-process claims 12-14.

Claims 1 and 12-14 have been amended for purposes of clarification of the invention. It is respectfully submitted that the amendment of these claims is neither narrowing nor made for substantial reasons of patentability. Accordingly, the amendments to these claims do not create prosecution history estoppel, and, in the event that claims are allowed and issue, the doctrine of equivalents is available for all of the elements of these claims.

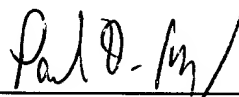
Claims 10, 11, 13 and 14 stand rejected under 35 U.S.C. 102(b) as being anticipated by Ogiso *et al.* (U.S. Pat. No. 5,959,391). Also, claims 10 and 12-14 are rejected as being anticipated by Kobayaski *et al.* (U.S. Pat. No. 5,716,481). These patents differ from Applicants' disclosed multilayer piezoelectric ceramic devices with base metal electrodes. As discussed hereafter, Ogiso *et al.* disclose a ceramic or other suitable piezoelectric material; electrodes are noble metals, preferably Ag as the main component (c.f, col. 3, line 58; col. 4, line 18). Kobayaski *et al.*, is directed to a method for manufacturing ceramic electronic components involving positioning and printing electrodes on unbaked ceramic layers. This art does not either individually or collectively anticipate Applicants' multilayer piezoelectric ceramic devices with base metal electrodes, let alone the specific combinations of components of Applicants' devices. For example, Applicants' devices have a base metal which is coated with material (i.e, glasses, metal oxides etc.) capable of protecting the base metal against oxidation. The art does not teach such protective coating. Accordingly, devices of the invention are substantially free of defects including lack of reduction of PZT or other ceramic material and lack of

oxidation of base metals. Decomposition products of organic materials in Applicants' devices are below 200 ppm. Also, the patentability of the specific combinations of components should be considered. The prior art, in general, therefore, discloses that piezoelectric devices can be made up of several different components. However, it is not seen where the combined teachings of the references disclose or suggest applicant's specific combinations of components as recited in independent claim 10. The Ogiso *et al.* and Kobayaski *et al.* patents are clearly distinguishable from the present invention. The rejection under 35 U.S.C. §102(b) should be withdrawn.

In view of the above remarks responsive to the subject Office Action, the Applicants believe that the rejections under 35 U.S.C. §§ 112 second paragraph, and 102(b) should be withdrawn. The claims as currently presented distinguish from the art references and represent patentable subject matter. Reconsideration and allowance, being in order, are earnestly solicited. Should there be further issues, the undersigned would welcome a telephone call to facilitate their resolution.

Respectfully submitted,

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## **VERSION WITH MARKINGS TO SHOW CHANGES MADE**

### **In the Specification:**

The paragraph beginning at line 3 of page 12 has been amended as follows:

[There are provided methods and compositions for co-fired] Co-fired multilayer piezoelectric ceramic materials with base metal electrodes based on copper, copper alloy, are found as an effective approach to manufacture low cost multilayer piezoelectrics. The method of the invention is performed at low firing temperature and without the oxidation of base metal or reduction of ceramic components. A variety of ceramic materials may be used and copper is the preferred base metal in the multilayer piezoelectric devices of the invention. This copper has additional protection against oxidation with a small inorganic coating on the surface. With such protection, the binder and other organics can also be efficiently removed and produce superior performance in the piezoelectric structured devices.

### **In the Claims:**

The claims have been amended as follows:

1. (Amended) A process for preparing a multilayer piezoelectric device with alternating piezoelectric ceramic layers and base metal layers as electrodes comprising the steps of:
  - (a) applying onto a first layer, which includes a piezoelectric ceramic material and a first combination of organic materials , a second layer, which includes a

base metal powder having particles, which are coated with material capable of protecting said base metal against oxidation, and a second combination of organic materials, to produce a first structure;

- (b) applying onto said first structure a second structure, which is identical to said first structure to produce a multilayer structure;
- (c) heating said multilayer structure at a temperature less than 600°C to remove said first and second combinations of organic materials and their decomposition products, such as carbon, to levels below 200 ppm; thereafter
- (d) sintering at a temperature from about 600°C to about 1050°C at a partial pressure of oxygen from about  $10^{-3}$  to  $10^{-15}$  atm to produce said multilayer piezoelectric device with alternating piezoelectric ceramic layers and base metal layers as electrodes .

- 12. (Amended) The device of claim [7] 10, wherein said base metal is selected from the group consisting of Cu, Ni and alloys thereof.
- 13. (Amended) The device of claim [7] 10, wherein said first combination of organic materials includes binder, solvents, plasticizers, dispersants, and combinations thereof.

14. (Amended) The device of claim [7] 10, wherein said second combination of organic materials includes solvents, binder, and combinations thereof.